Claims

[c1] 1.A fuel cell assembly comprising:
a housing having an inlet and an outlet and defining at least one bypass flow channel, said bypass flow channel being configured to be in fluid communication with said inlet, said inlet and outlet being configured to provide fluid communication to and from said housing, respectively;
at least one fuel cell stack disposed within said housing and defining at least one direct flow channel, said at least one fuel cell stack comprising at least one fuel cell, and said direct flow channel being configured to be in fluid communication with said inlet and outlet; and
a control system, which is configured to control an oxidant flow from said inlet to said direct and bypass flow channels.

[c2] 2.The fuel cell assembly of Claim 1, wherein said bypass flow channel is further configured to be in fluid communication with said outlet.

[c3] 3.The fuel cell assembly of Claim 2, wherein said control system is configured to adjust the oxidant flow to said direct and bypass flow channels in response to a feedback signal.

[c4] 4.The fuel cell assembly of Claim 3, wherein said control system comprises:
at least one flow regulator, which is configured to regulate the oxidant flow to said direct and bypass flow channels;
a flow controller, which is configured to receive the feedback signal and to actuate said at least one flow regulator; and
at least one control sensor, which is configured to supply the feedback signal to said flow controller.

[c5] 5.The fuel cell assembly of Claim 4, wherein said control sensor is configured to monitor a parameter selected from the group consisting of temperature, voltage, electrical current, and heat flux.

[c6] 6.The fuel cell assembly of Claim 5, wherein said control sensor comprises a temperature sensor.

[c7] 7.The fuel cell assembly of Claim 6, wherein said control sensor comprises an

invasive temperature sensor, which is in intimate contact with a downstream control point.

[c8] 8.The fuel cell assembly of Claim 7, wherein said control sensor comprises a non-invasive temperature sensor, which is in remote communication with an upstream control point.

[c9] 9.The fuel cell assembly of Claim 4, wherein said flow regulator comprises at least one control valve.

[c10] 10.The fuel cell assembly of Claim 2, wherein said bypass oxidant flow channel is defined by said fuel cell stack and said housing and extends along an inner surface of said housing.

[c11] 11.The fuel cell assembly of Claim 2, further comprising a flow liner disposed within said housing, wherein said bypass flow channel is disposed between said flow liner and said housing and extends along an inner surface of said housing.

[c12] 12.The fuel cell assembly of Claim 2, wherein said outlet is configured to be in fluid communication with a subsequent inlet of a subsequent fuel cell assembly.

[c13] 13.The fuel cell assembly of Claim 2, wherein said inlet is configured to be in fluid communication with a preceding outlet of a preceding fuel cell assembly.

[c14] 14.The fuel cell assembly of Claim 2, wherein said housing is configured to be pressurized, and wherein said inlet is configured to be in fluid communication with a preceding outlet of a turbine engine.

[c15] 15.The fuel cell assembly of Claim 2, wherein said housing is configured to be pressurized, and wherein said outlet is configured to be in fluid communication with a subsequent inlet of a turbine engine.

[c16] 16.The fuel cell assembly of Claim 1, wherein said bypass flow channel is configured to recycle at least a portion of the oxidant flow through said bypass flow channel to said inlet.

[c17] 17.The fuel cell assembly of Claim 1, wherein each of said fuel cells is selected from the group consisting of a solid oxide fuel cell, a proton exchange

membrane fuel cell, a molten carbonate fuel cell, a phosphoric acid fuel cell, an alkaline fuel cell, a direct methanol fuel cell, a regenerative fuel cell, a zinc air fuel cell, and a protonic ceramic fuel cell.

[c18] 18.The fuel cell assembly of Claim 17, wherein said housing comprises a pressure vessel, and each of said fuel cells comprises a solid oxide fuel cell.

[c19] 19.The fuel cell assembly of Claim 1, wherein said at least one fuel cell stack comprises a plurality of planar fuel cells arranged in a stack.

[c20] 20.The fuel cell assembly of Claim 1, wherein said at least one fuel cell stack comprises a plurality of fuel cells arranged in a tubular configuration.

[c21] 21.A fuel cell assembly comprising:
a housing having an inlet and an outlet, said inlet and outlet being configured to provide fluid communication to and from said housing, respectively;
at least one bypass flow duct extending along said housing and configured to be in fluid communication with said inlet;
at least one fuel cell stack disposed within said housing and defining at least one direct flow channel, said at least one fuel cell stack comprising at least one fuel cell, and said direct flow channel being configured to be in fluid communication with said inlet and outlet; and
a control system, which is configured to control an oxidant flow from said inlet to said direct flow channel and said bypass flow duct.

[c22] 22.The fuel cell assembly of Claim 21, wherein said bypass flow duct is further configured to be in fluid communication with said outlet.

[c23] 23.The fuel cell assembly of Claim 21, wherein said bypass flow duct extends along an outer wall of said housing.

[c24] 24.The fuel cell assembly of Claim 21, wherein said bypass flow duct is disposed within said housing.

[c25] 25.The fuel cell assembly of Claim 21, wherein the control system regulates the oxidant flow through said direct flow channel and said bypass flow duct in response to a feedback signal.

[c26] 26.A solid oxide fuel cell assembly comprising:

a pressure vessel having an inlet and an outlet and defining at least one bypass flow channel, said bypass flow channel being configured to be in fluid communication with said inlet, said inlet and outlet being configured to provide fluid communication to and from said pressure vessel respectively;

at least one planar solid oxide fuel cell stack disposed within said pressure vessel and defining at least one direct flow channel, said at least one planar solid oxide fuel cell stack comprising at least one planar solid oxide fuel cell, and said direct flow channel being configured to be in fluid communication with said inlet and outlet; and

a control system, which is configured to adjust an oxidant flow from said inlet to said direct and bypass flow channels in response to a feedback signal.

[c27] 27.The solid oxide fuel cell assembly of Claim 26, wherein said at least one planar solid oxide fuel cell stack comprises a plurality of planar solid oxide fuel cells arranged in a stack.

[c28] 28.The solid oxide fuel cell assembly of Claim 26, wherein said control system comprises:

a flow regulator, which is configured to regulate the oxidant flow to said direct and bypass flow channels;

a flow controller, which is configured to communicate a temperature feedback signal and to actuate said at least one flow regulator, the feedback signal comprising the temperature feedback signal; and

at least one temperature sensor, which is configured to generate the temperature feedback signal from at least one control point and communicate the temperature feedback signal to said flow controller.

[c29] 29.The solid oxide fuel cell assembly of Claim 26, wherein said control system is further configured to repeatedly monitor the temperature feedback signals.

[c30] 30.The fuel cell assembly of Claim 26, wherein said inlet is configured to be in fluid communication with a preceding outlet of a turbine engine.

[c31] 31.The fuel cell assembly of Claim 26, wherein said outlet is configured to be in

fluid communication with a subsequent inlet of a turbine engine.

[c32] 32.A method for controlling a thermal environment of a fuel cell stack, the fuel cell stack comprising at least one fuel cell, being disposed within a housing and having at least one direct flow channel, the housing having an inlet and an outlet, and the inlet being in fluid communication with the direct flow channel and with a bypass flow channel, said method comprising:
apportioning an oxidant flow between the direct and bypass flow channels.

[c33] 33.The method of Claim 32, wherein said apportionment comprises adjusting the oxidant flow through the direct and bypass flow channels in response to a feedback signal output.

[c34] 34.The method of Claim 33, wherein said adjustment comprises:
monitoring the thermal environment of the fuel cell stack to generate the feedback signal output; and
actuating at least one flow regulator positioned at the inlet in response to the feedback signal output, the flow regulator being configured to alter the oxidant flow from the inlet to the direct and bypass channels.

[c35] 35.The method of Claim 34, wherein said monitoring comprises:
measuring a parameter selected from the group consisting of temperature, voltage, current and heat flux at a plurality of time steps to obtain a measured parameter value; and
comparing the measured parameter value with a predetermined parameter value.

[c36] 36.The method of Claim 34, wherein said monitoring comprises measuring a temperature value within the housing and comparing the temperature value with a predetermined temperature value to generate the feedback signal output.

[c37] 37.The method of Claim 36, further comprising repeating said monitoring and actuating steps to maintain the temperature value within a predetermined temperature range.

[c38] 38.The method of Claim 33, wherein said adjustment comprises:

monitoring the thermal environment of the fuel cell stack to generate the feedback signal output; and
actuating at least one flow regulator positioned upstream of the fuel cell stack, in response to the feedback signal output, the flow regulator being configured to apportion the oxidant flow through the direct and bypass channels.

[c39] 39.The method of Claim 32, further comprising recycling a portion of the oxidant flow through the bypass flow channel to the inlet.

[c40] 40.A fuel cell assembly comprising:
a housing having an inlet and an outlet and defining at least one bypass flow channel, which is configured to be in fluid communication with said inlet and said outlet, said inlet and outlet being configured to provide fluid communication to and from said housing, respectively;
at least one fuel cell stack disposed within said housing and defining at least one direct flow channel, said at least one fuel cell stack comprising at least one fuel cell, and said direct flow channel being configured to be in fluid communication with said inlet and outlet; and
a control system, which is configured to control an oxidant flow through said direct and bypass flow channels.

[c41] 41.The fuel cell assembly of Claim 40, wherein said control system comprises:
a plurality of flow regulators positioned upstream of said fuel cell stack, each of said flow regulators being configured to regulate the oxidant flow to said direct and bypass flow channels;
a flow controller, which is configured to receive a feedback signal and to actuate each of said flow regulators; and
at least one control sensor, which is configured to supply the feedback signal to said flow controller.